Fire Behavior (FB)
Sampling Method

EXECUTIVE SUMMARY

The Fire Behavior (FB) methods are used to describe the behavior of the fire and the ambient weather conditions that influence the fire behavior. Fire behavior methods are not plot based and are collected by fire event and time-date. In general, the fire behavior data are used to interpret the fire effects documented in the plot-level sampling. Unlike the other plot-level sampling methods, the Fire Behavior methods are documented observations taken for one fire event, not for the FIREMON macroplots. The FireID field in the PD method links this database to the plot level data. The Flame Length, Spread Rate and Fire Behavior Picture fields in the PD method allow you to enter plot specific fire behavior data.

INTRODUCTION

Fire managers achieve desired fire effects (e.g., 50 percent mortality, 60 percent fuel consumption) by burning under narrow environmental conditions that create desired fire behavior. In fact, fire behavior is the only direct observation that the fire manager can use to judge the outcome for desired fire effect. Fire managers must juggle weather conditions such as temperature, humidity, and wind, with fuel moistures and topography to get a flame length or fireline intensity that will ultimately satisfy the burn objectives by generating the desired fire effects. The only way the fire manager can successfully perform this complex balancing act is to get extensive experience burning across the wide range environmental conditions *and* to review the results of others who burn under the same conditions. One way that fire managers can document their experience is to record environmental conditions and resultant fire behavior in a database so that others can reference the conditions and then compare them with the actual results of the burn or the fire effects.

The FIREMON Fire Behavior (FB) methods were designed to document the weather conditions at the time of the fire and the fire behavior that resulted from those conditions. The data are linked to the plot level sampling by a common field so that they can then be used to interpret the effects of that burn. For example, it is very informative to know that the 50 percent fuel consumption measured using the FL methods was achieved with 70 degrees F temperature, 30 percent relative humidity, and 12 percent 1000-hr fuel moistures.

The Fire Behavior methods are unlike the other FIREMON methods in that the FB methods are recorded by fire rather than plot. For example, 50 FIREMON macroplots located in a 500-acre prescribed fire unit are all burned with the same fire, then they all will be linked to that fire in the FB table. The Fire Behavior method and database table are used to document the fire behavior at the time of the burn. Each macroplot is linked to this fire behavior information via the Fire ID in the PD form. The fire manager can query the Fire Behavior data to determine the burning conditions, fire behavior and resultant fire effects on each of the burned plots.

Obviously, not all fields in the Fire Behavior database need to be filled or recorded, only the ones actually measured or observed at the fire.

SAMPLING PROCEDURE

The sampling procedures for all FB procedures are documented in many other publications, most notably the Fire Observer's Handbook, and will not be described here. This method is presented in the order of the fields in the FB data table.

Fire Information

Field 1: Fire ID – Enter a Fire ID of up to 15 characters. The ID number or name that relates the fire to plots in the PD table. This field links this fire scale data with the plot scale data in the PD method.

Field 2: Fire Date – Enter the date of fire as an 8-digit number in the MM/DD/YYYY format where MM is the month number, DD is the day of the month and YYYY is the current year. For example, April 01, 2001 would be entered 04/01/2001.

Field 3: Fire Time – Enter the time of day that these observations were recorded. Use 24-hr time. For example if it is 8 am enter 0800 id it is 8 pm enter 2000.

Field 4: Fire Name - The name of the fire is entered in this field as a 25-character (or less) code in this field. This is a non-standardized field so anything can be entered here, but we suggest the name follow the convention used by fire management where it is derived from the drainage or major landmark where the fire starts.

Field 5: Reference Fire ID – Enter a unique 20-character fire code taken from the database of other fire management agencies. Record the source of this reference ID in the FIREMON metadata table.

Field 6: Units (E/M) – Units of measure. **E** - English or **M** - Metric.

Ambient Weather Conditions

The next set of fields allows the fire manager to store the weather conditions at various times during the burn. These weather data can be measured onsite or downloaded from a RAWS station or other weather station near the burn. The source of this data is recorded in the FIREMON metadata table.

Field 7: Temperature (degrees F/degrees C) – Enter the temperature at the time and date listed in Fields 2 and 3.

Field 8: Relative Humidity (percent) – Enter the relative humidity measured at the specified date and time.

Field 9: Windspeed (miles/hr or km/hr) – Enter the typical windspeed recorded at the specified date and time.

Field 10: Percent Cloudy (percent) – Enter the percent cloudiness at the specified date and time.

Fuel Moistures

The next set of fields describes the measured fuel moistures at the date and time of burn. Standard fuel moisture measurement techniques should be employed. Basically there are two methods of measuring fuel moistures. The oven-dry method requires that multiple samples of all the fuels class sizes be collected in the field, stored in airtight containers (e.g. zip-close bags) and brought back promptly to be weighed and dried. The mass of the individual samples is measured first, and then the samples are put in an oven at 100 degrees C. The 1- and 10-hr fuels, and litter and duff should be dry in 24 hours. Weight a few selected samples of the larger fuels every 24 hours until they reach equilibrium. When the piece weights of a class, for example the 100-hr fuel class, reach equilibrium then you can make a final weight of all of the pieces in the class. Calculate the percent moisture (by weight) for each fuel class by taking the difference of the wet and dry weights and dividing by the dry weight. The fuel moisture for a class is the average moisture measured across all of the samples. When cutting pieces off logs for fuel samples you do not need to cut them thicker than 3 inches (7.5 cm). Doing so will unnecessarily extend the drying time. If you use this method you will not be able to enter the fuel moisture data the day of the fire.

The second method involves indirect measurements of fuel moisture using probes or other instrumentation.

Record the method of fuel moisture measurement in the FIREMON metadata table.

Field 11: 1 Hour Fuel Class Moisture (percent) **–** Enter the fuel moisture of the 1 hour downed dead woody fuel class (less than 0.25 inches or 1 cm in diameter).

Field 12: 10 Hour Fuel Class Moisture (percent) **–** Enter the fuel moisture of the 10 hour downed dead woody fuel class (0.25-1.0 inches or 1-2.5 cm in diameter).

Field 13: 100 Hour Fuel Class Moisture (percent) **–** Enter the fuel moisture of the 100 hour downed dead woody fuel class (1.0-3.0 inches or 2.5-7.5 cm in diameter).

Field 14: 1000 Hour Fuel Sound Class Moisture (percent) **–** Enter the fuel moisture of the sound 1000 hour downed dead woody fuel class (greater than 3.0 inches or 7.5 cm in diameter).

Field 15: 1000 Hour Fuel Rotten Class Moisture (percent) **–** Enter the fuel moisture in percent of the rotten 1000 hour downed dead woody fuel class (greater than 3.0 inches or 7.5 cm in diameter).

Field 16: Litter Moisture (percent) **–** Enter the moisture of the litter layer. This is the layer that contains recognizable needles, cone scales and leaves.

Field 17: Duff Moisture (percent) – Enter the moisture of the duff layer. This is the layer that contains unrecognizable decomposing organic material. Try to get a moisture for the entire duff profile.

Field 18: Soil Moisture (percent) – Enter the moisture of the uppermost soil layer. This is the top 10 cm of mineral soil just below the duff layer.

Field 19: Live Shrub Moisture (percent) – Enter the moisture of the live shrubs.

Field 20: Live Herb Moisture (percent) – Enter the moisture of the live herbaceous plants.

Field 21: Live Crown Moisture (percent) – Enter the moisture of the live tree crown foliage. Take samples from all parts of the tree crowns.

Fire Behavior

The last set of fields describes the measured or observed fire behavior of the fire at the selected time and date. Fire behavior is often observed rather than measured. Follow the directions in the Fire Observers Handbook when estimating these standard fire behavior characteristics.

Field 22: Fire Type – Enter the code that best describes the fire that is described by the following observations in Fields 23 through 27.

F – Flanking
B – Backing
H – Head
C – Crown.

Field 23: Flame Length (ft/m) – Estimate flame length at this time and date of this. Precision: $\pm$1 ft/0.3 m

Field 24: Flame Depth (ft/m) – Estimate flame depth at this time and date of this fire. Precision: $\pm$1 ft/0.3 m

Field 25: Spread Rate (ft/min. or m/min.) – Estimate the average speed of the fire at this time and date. To estimate this parameter, using a watch, note the time it takes the flame front to go 30 feet or 10 meters and then divide 10 by the number of minutes (or fraction of).

Field 26: Plume Behavior – Estimate the dynamics of the plume using the following codes.

WV –Plume well ventilated, rising, and dispersing high above burn
US – Plume unstable and its behavior is erratic.
PD – Plume is dropping and going downhill into the valleys

Field 27: Spotting Observations – Estimate the spotting behavior of the fire at this time and date using the following codes.

SD – Spotting downslope or downwind
SU – Spotting upslope or upwind.
SE – Spotting is erratic and very random
NS – No spotting observed
NA – Difficult to determine spotting due to smoke or obstruction

Local Codes and Comments

Field 28: Local Code 1 – Enter a user designed code that is up to 20 characters in length, and uniquely describes some condition on the FIREMON plot. Do not to embed blanks in your codes to avoid confusion and database problems. Document your coding method in the Comments field.

Field 29: Local Code 2 – Enter a user designed code that is up to 20 characters in length, and uniquely describes some condition on the FIREMON plot. Do not to embed blanks in your codes to avoid confusion and database problems. Document your coding method in the Comments field.

Field 30: Comments – Memo field. 60,000+ characters used to record any information pertinent to the FB information. Text information can be pasted from word documents, Access databases, Excel spreadsheets or any other software that can copy text to the windows clipboard.